

### REMARKS

The Specification is objected to, Claims 1-14 and 37 are rejected under 35 USC §112, Claims 1-13 are rejected under 35 USC §102, Claims 14 and 37 are rejected under 35 USC §103, Claims 1-13 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting and Claim 1-14 are provisionally rejected under 35 USC §103. The applicants respectfully traverse these rejections and request reconsideration of the application in view of the above amendments and the following remarks.

The Specification and Claims 1, 4 and 5 have been amended and Claims 6, 7 and 37 have been canceled. None of these changes constitute new matter since this clarification of the claims is supported by the original disclosure.

### OBJECTIONS TO THE SPECIFICATION

The Specification is objected to for having new matter introduced by the previous amendment. The Specification has been amended to delete language relating to wt% of platinum.

### REJECTIONS UNDER 35 USC §112

Claims 1-14 and 37 were rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement. Specifically, the Office Action suggests that in Claim 1 "a metal consisting essentially of" has no support, in Claim 2 the Specification does not support a catalyst having a silicon to gallium atomic ratio greater than 5, and in Claims 5, 6, and 7 the Specification does not support the percentage of the platinum based on wt%.

Claim 1 has been amended deleting the phrase "a metal consisting essentially of". Claim 1 now reads in part "a catalyst consisting essentially of a zeolite having gallium and silicon in the

framework on which platinum has been deposited". This change in language has been made to Claim 1 to clarify the claimed subject matter.

The Specification has been amended and now reads "[t]he silicon to gallium atomic ratio (Si:Ga) of the MFI zeolite is preferably greater than 5". The words "silicon" and "gallium" were inadvertently transposed in the original transcription of the Specification. Support for this language is found on page 10, line 23, for the atomic ratio "Si:Ga" and in Claim 2. Further support is found on page 13, Table 2. The elemental analysis of the Ga-ZSM-5 of Example 1 which has weight % of Si of 41.72% and weight % of Ga of 1.14% which would result in a silicon to gallium atomic ratio of 91.5 which is greater than 5.

Claim 5 has been amended and now reads in part "wherein platinum is present at 0.86wt%". Support for this language is found on page 14, line 11. This change in language has been made to Claim 5 to clarify the claimed subject matter. Claims 6 and 7 have been canceled.

#### REJECTIONS UNDER 35 USC §102

Claims 1-13 were rejected under 35 USC §102(b) as being anticipated by U. S. Patent no. 4,766,265 to Desmond et al ("Desmond"). Specifically, the Office Action suggests that Desmond discloses a process of aromatization of alkanes, such as ethane to aromatics, in the presence of a catalyst containing gallium zeolite having ZSM-5 structure with a Si/Ga ratio of 10:1-100:1 on which platinum has been deposited and at a temperature of 500-700°C, a pressure of ambient to 20 atm and a space velocity from about 0.1 to about 50.

Claim 1 has been amended and now reads in part "a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum has been deposited". The

claim language limits the metal deposited on the zeolite to platinum. Desmond discloses a process for the conversion of ethane to liquid aromatic hydrocarbons with a catalyst promoted with rhenium and a metal selected nickel, palladium, platinum, rhodium and iridium (Abstract; col., 3, lines 45-49; col. 4, lines 17-20; col. 7, lines 40-42). Rhenium is a required and essential component of the metal deposited on the zeolite catalyst disclosed in Desmond. There is no disclosure in Desmond of the claimed invention of a deposited metal which does not contain rhenium.

A reference cited as prior art for anticipation under 35 USC §102(b) must teach each and every element of the claimed invention [Hybritech Inc. v. Monoclonal Antibodies, Inc., 231 USPQ 81, 90 ( Fed. Cir. 1986)]. The cited reference must disclose all of the claimed elements arranged as in the claim [Richardson v. Suzuki Co., 9 USPQ 2d 1913, 1920 (Fed. Cir. 1989)]. The law requires identity between the claimed invention and the cited reference which must teach the entirety of the claimed invention [Structural Rubber Products, Co. v. Park Rubber Co., 223 USPQ 1264, 1271 (Fed. Cir. 1984)].

Desmond does not meet the requirements for a reference cited for anticipation. Desmond does not disclose or even suggest a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum (without rhenium) has been deposited. Claim 1 now claims subject matter not anticipated by Desmond.

#### REJECTIONS UNDER 35 USC §103

Claim 14 is rejected under 35 USC §103(a) as being unpatentable over Desmond. Specifically, the Office Action suggests that Desmond discloses a process of aromatization of alkanes as described above and a molecular sieve which can contain alkali metal.

Claim 37 is rejected under 35 USC §103(a) as being unpatentable over Desmond considered with Bernard. Specifically, the Office Action suggests that Bernard discloses an aromatization catalyst treated with sulfur and reduced with hydrogen.

Desmond, alone or in combination with Bernard, does not teach, disclose or suggest a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum has been deposited. As noted above, Desmond requires the presence of rhenium deposited on the zeolite.

Every limitation in the claims must be given effect rather than considering one in isolation from the others [In re Geerdes, 491 F2d 1260, 180 USPQ 789(CCPA 1974)]. The patentable difference of the present invention over the reference is that the catalyst of the claimed invention is a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum has been deposited.

MPEP §2142 establishes the criteria for establishing a *prima facie* case of obviousness and requires some suggestion or motivation to modify the reference. Such suggestion or motivation for a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum (without rhenium) has been deposited did not exist. MPEP§2142 also requires a reasonable expectation of success. While it may have been obvious-to-try a process for the aromatization of hydrocarbons using a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum (without rhenium) has been deposited, obvious-to-try is not equivalent to a reasonable expectation of success. Further, according to MPEP§2142, the prior art reference must teach or suggest all the claim limitations. The cited references do not teach

or suggest using a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum (without rhenium) has been deposited for a process for the aromatization of hydrocarbons.

Even if a *prima facie* case of obviousness were established by the cited references, the unexpected results of the claimed invention would satisfy the requirements of patentability. As shown in the Affidavit under 37 CFR §1.132 filed with the response mailed July 11, 2005 (a copy of which is attached for the examiner's convenience), zeolite catalysts were compared in a process for aromatization of alkanes. One was a catalyst of the claimed invention, a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum has been deposited (Example 1). Another was a catalyst as in Desmond, a zeolite having gallium and silicon in the framework on which platinum and rhenium had been deposited (Comparative Example 1). Both catalysts were treated first with hydrogen, second with a sulfur compound, and then again with hydrogen. The results shown in the Affidavit for Example 1 demonstrate the improvements and unexpected results of the claimed invention and distinguish the claimed invention from Desmond. In a process for aromatization of alkanes a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum has been deposited has better performance in yield to aromatics, such as benzene, toluene and xylene (BTX) than that for a catalyst of a zeolite having gallium and silicon in the framework on which a platinum and rhenium. The effect is apparent even when the catalyst has not been treated first with hydrogen, second with a sulfur compound, and then again with hydrogen as shown in Table 2 of the Affidavit.

The examiner claims the results are inconsistent. The examiner argues that in Table 1 (with sulfur pretreatment) of the Affidavit the BTX selectivity of Example 1 is only 41% while that of the Comparative Example is 42% and that in Table 2 (without sulfur pretreatment) of the Affidavit the conversion of Example 1 is only 62% while that of the Comparative Example is 63%. Conversion is a measure of the per cent of feed converted but it does not take into account that the product of the conversion may not be the products desired, i.e., propane could be converted 100% to carbon dioxide. Selectivity is a measure of the percent of product which is the desired product but does not take into account the portion of feed converted, i.e., there may be a high proportion of acrylic acid in the products but only a small amount of propane might be converted. Yield of a desired product is a measure of conversion and selectivity and is a better measure of performance than either of the other factors. In both cases, with sulfur pretreatment (Table 1) and without pretreatment (Table 2), the yield for BTX (conversion times selectivity) is better for Example 1 than that for the Comparative Example.

#### PROVISIONAL REJECTIONS

Claims 1-13 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting over Claims 1, 5, 7-9, 15 and 16 of copending application no. 10/748,418 and Claims 1-14 were provisionally rejected under 35 USC §103(a) as being obvious over copending application no. 10/748,418.

Claims 1, 5, 7, 8 of copending application 10/748,418 have been amended and Claim 9 has been canceled. The current Listing of Claims in the Application for copending application 10/748,418 is attached beginning on page 18 of this paper. Claim 1 of copending application

10/748,418 now reads in part "the catalyst consists essentially of platinum deposited on an aluminosilicate MFI zeolite". Claim 1 of the present invention reads in part "a catalyst consisting essentially of a zeolite having gallium and silicon in the framework on which platinum has been deposited". Claim 1 of copending application 10/748,418 limits the MFI zeolite to an aluminosilicate. Claim 5 of copending application 10/748,418 has been amended to delete reference to the catalyst containing gallium, boron or beryllium substituted for the aluminum. Claim 1 of the present invention specifically includes gallium as a component of the zeolite. Furthermore, in the Specification on page 10, line 22-23, the zeolite of the present invention is clearly defined as essentially aluminum-free, e.g., no more than 500 ppm aluminum. Claim 1 of copending application 10/748,418 defines the catalyst to be an aluminosilicate.

In summary, the claims of the present invention are for an essentially aluminum-free zeolite of gallium and silicon whereas the claims of copending application 10/748,418 are for an aluminosilicate which does not contain an essential amount gallium. The two sets of claims are mutually exclusive in the descriptions of the catalysts, i.e., the catalyst of the present invention has gallium and silicon but essentially no aluminum and the catalyst of 10/748,418 has aluminum and silicon but essentially no gallium. The provisional rejection under the judicially created doctrine of obviousness-type double patenting over Claims 1, 5, 7-9, 15 and 16 of copending application no. 10/748,418 does not meet the criteria for establishing obviousness-type double patenting.

Claim 1 has been amended and now reads in part "wherein the catalyst has been treated first with hydrogen, second with a sulfur compound; and then again with hydrogen". Support for this language is found on the second full paragraph on page 12 after line 4 added in the previous

response, Claim 37, now canceled and Claim 21, now withdrawn. This change in language has been made to Claim 1 to clarify the claimed subject matter. Claim 1 now includes subject matter not found to be obvious over copending application 10/748,418.

#### MISCELLANEOUS

Claim 4 as originally filed did not specify the claim on which it depended. Claim 4 has been amended to depend on Claim 3.

A Petition and Fee for Extension of Time under 37 CFR §1.136(a) is being filed concurrently with this paper. A Request for Continued Examination (RCE) under 37 CFR §1.114 is being filed concurrently with this paper. The Commissioner is hereby authorized to charge the fee of \$450.00 under 37 CFR §1.17(a)(2), the fee of \$790.00 under 37 CFR §1.17(e) and any additional fees due by filing this paper or to credit any overpayment to Account No. 502025.

On the basis of the above amendments and remarks, reconsideration of this application is requested and its allowance of the claims is requested at the examiner's earliest convenience. No new matter has been added.

Respectfully submitted,



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### LISTING OF CLAIMS IN THE APPLICATION

1 (Currently amended). A process for the aromatization of hydrocarbons comprising:

- a) contacting an alkane containing 2 to 6 carbon atoms per molecule with ~~at least one~~ catalyst ~~comprising~~consisting essentially of a zeolite having gallium and silicon in the framework on which ~~a metal consisting essentially of~~ platinum has been deposited wherein the catalyst has been treated first with hydrogen, second with a sulfur compound, and then again with hydrogen; and
- b) recovering an aromatic product.

2 (Previously presented). The process of claim 1 wherein the zeolite has a silicon to gallium atomic ratio (Si/Ga) greater than 5.

3 (original). The process of claim 2 wherein the silicon to gallium atomic ratio in the range of from 5-400.

4 (Currently amended). The process of claim 3 wherein the silicon to gallium atomic ratio in the range of from 25-250.

5 (Currently amended). The process of claim 1 wherein platinum is present ~~in the range of from 0.05wt% to 3wt%~~ at 0.86wt%.

6. Canceled

7. Canceled

8 (original). The process of claim 1 wherein the contact between the alkane and the catalyst is at a space velocity in the range between 0.1 and 100 h<sup>-1</sup>.

9 (original). The process of claim 8 wherein the contact between the alkane and the catalyst is at a temperature in the range between 200 and 600°C.

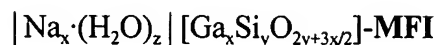
10 (original). The process of claim 9 wherein the contact between the alkane and the catalyst is at a pressure in the range between 5 and 215 psia.

11 (original). The process of claim 1 wherein the zeolite has a MFI, FAU, TON, MFL, VPI, MEL, AEL, AFI, MWW or MOR structure.

12 (original). The process of claim 11 wherein the zeolite has a MFI structure.

13 (original). The process of claim 12 wherein the zeolite has a ZSM-5 MFI structure.

14 (Previously presented). The process of Claim 1 wherein the sodium form of the zeolite is represented as:



where  $x=0.1-25$ ;  $y=60-100$ ; and  $z=0.1-10$ .

15 (withdrawn). A process for synthesizing a platinum-gallium zeolite catalyst comprising:

- a) preparing a gallium zeolite containing silicon and gallium;
- b) depositing platinum on the zeolite; and
- c) calcining the zeolite.

16 (withdrawn). The process of claim 15 wherein the platinum is deposited by cationic exchange.

17 (withdrawn). The process of claim 15 wherein the platinum is deposited by impregnation.

18 (withdrawn). The process of claim 15 wherein the zeolite has an MFI, FAU, TON, MFL, VPI, MEL, AEL, AFI, MWW or MOR structure.

19 (withdrawn). The process of claim 18 wherein the zeolite has a MFI structure.

20 (withdrawn). The process of claim 19 wherein the zeolite has a ZSM-5 MFI structure.

21 (withdrawn). The process of claim 15 wherein the catalyst is subsequently treated first with hydrogen, second with a sulfur compound; and then again with hydrogen.

22 (withdrawn). A platinum gallium zeolite catalyst for aromatization of hydrocarbons comprising:

a) a gallium-silicon zeolite; and

b) platinum deposited on the gallium-silicon zeolite.

23 (withdrawn). The catalyst of claim 22 wherein the silicon to gallium atomic ratio is greater than 5.

24 (withdrawn). The catalyst of claim 23 wherein the silicon to gallium atomic ratio in the range of from 5-400.

25 (withdrawn). The catalyst of claim 24 wherein the silicon to gallium atomic ratio in the range of from 25-250.

26 (withdrawn). The catalyst of claim 22 wherein platinum is present in the range of from 0.05% to 3%.

27 (withdrawn). The catalyst of claim 26 wherein platinum is present in the range of from 0.2% to 2%.

28 (withdrawn). The catalyst of claim 27 wherein platinum is present in the range of from 0.2% to 1.5%.

29 (withdrawn). The catalyst of claim 22 wherein the pore size of the zeolite is in the range from 2 to 200 angstroms.

30 (withdrawn). The catalyst of claim 29 wherein the pore size of the zeolite is in the range from 2 to 100 angstroms.

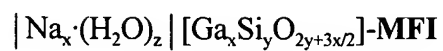
31 (withdrawn). The catalyst of claim 30 wherein the pore size of the zeolite is in the range from 2 to 20 angstroms.

32 (withdrawn). The catalyst of claim 22 wherein the zeolite has a MFI, FAU, TON, MFL, VPI, MEL, AEL, AFI, MWW or MOR structure.

33 (withdrawn). The catalyst of claim 22 wherein the zeolite has a MFI structure.

34 (withdrawn). The catalyst of claim 22 wherein the zeolite has a ZSM-5 MFI structure.

35 (withdrawn). The catalyst of claim 22 wherein the catalyst is represented by the formula



where  $x=0.1-25$ ;  $y=60-100$ ; and  $z=0.1-10$ .

36 (withdrawn). The catalyst of claim 22 wherein its X-ray diffraction pattern has peaks at 11.19, 9.98, 9.77, 6.37, 5.99, 3.86, 3.82, 3.76, 3.72 and 3.65 angstroms.

37. Canceled

**LISTING OF CLAIMS IN COPENDING APPLICATION 10/748,418**

- 1 (Currently amended). A process for aromatization of alkanes comprising contacting an alkane having one to four carbon atoms per molecule with a ~~Pt/ZSM-5~~ catalyst under conditions to convert the alkane to benzene, toluene and xylenes and byproducts of methane and ethane wherein the catalyst consists essentially of platinum deposited on an aluminosilicate MFI zeolite.
- 2 (original). The process of Claim 1 wherein the catalyst has a silicon to aluminum atomic ratio (Si:Al) is greater than 2.
- 3 (original). The process of Claim 2 wherein the silicon to aluminum atomic ratio is in the range from 10 to 200.
- 4 (original). The process of Claim 3 wherein the silicon to aluminum atomic ratio is in the range from 20 to 100.
- 5 (Currently amended). The process of Claim 1 wherein the catalyst ~~contains gallium, boron or beryllium substituted for the aluminum~~ is Pt/ZSM-5.
6. Canceled
- 7 (Currently amended). The process of Claim 1 wherein platinum is present in the range from ~~0.05 to 5%~~ 0.06 wt% to 0.33 wt%.
8. (Currently amended). The process of Claim 1 wherein platinum is present in the range from ~~0.05 to 5%~~ 0.1 wt% to 0.3 wt%.
9. Canceled
- 10 (original). The process of Claim 1 wherein the catalyst is bound by oxides of magnesium, aluminum, titanium, zirconium, thorium, silicon, boron or mixtures thereof.

11 (original). The process of Claim 1 wherein the catalyst has an amorphous support.

12 (original). The process of Claim 11 wherein the amorphous support is an oxide of aluminum (alumina) or silicon (silica).

13 (original). The process of Claim 1 wherein the chemical formula of the zeolite is represented as:



14 (Previously amended). The process of Claim 1 wherein the process is a dehydrocyclodimerization process of a C<sub>3</sub> alkane to benzene, toluene and xylenes.

15 (original). The process of Claim 14 wherein the temperature is in the range of from 350°C to 650°C.

16 (original). The process of Claim 14 wherein the pressure is in the range of from 10 to 2000 kPa gauge.

17 (original). The process of Claim 1 wherein the mole fraction ratio of ethane relative to methane is in the range from 2 to 10.